

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

22 SEP 1994

FROM: HQ AFCEA/EN
139 Barnes Drive
Tyndall AFB FL 32403-5319

SUBJECT: Engineering Technical Letter (ETL) 94-4:
Energy Usage Criteria for Facilities in the Military Construction Program

1. Purpose. This ETL:

1.1. Establishes standards and minimum criteria to ensure energy conserving designs are developed for new construction, additions, and major renovation/repair projects for facilities on military installations.

1.2. Establishes reporting requirements for the Air Staff (AF/CEC), MAJCOMs, FOAs, DRUs and bases in the Programming, Design, and Construction (PDC) system.

2. Application. This ETL applies to:

- o New facilities.
- o All additions.
- o Major renovations/repairs. These projects will be programmed and funded to upgrade facilities to new building energy usage levels.

2.1. Authority. This ETL supersedes ETL 87-4, 13 Mar 1987 and ETL 84-2, 27 Mar 1984. It contains changes precipitated by the implementation of energy conservation standards specified in the Code of Federal Regulations (10 CFR 435).

2.2. Effective Date: Immediately for projects which have not reached the 10 percent design stage as of the date of this letter.

3. Definitions.

3.1. Major Renovations/Repairs: Changes in the building envelope, and/or replacement of any one or more of the following systems: lighting, HVAC, and water heating.

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3.2. Similar buildings: Buildings which are essentially the same (within 10 percent of the number of square feet, same type of construction, functioning hours of operation, and number of stories) as other existing buildings on the installations which have been the subject of energy conservation analysis.

3.3. Process Energy (including plug loads): Energy consumed in support of all functions other than comfort and amenities for building occupants. Buildings with an excess of 60 percent process energy are exempt from meeting the EUB requirement, but will meet the mandatory minimum compliance standards.

3.4. Energy Use Budget (EUB): The calculated measure, in 1000 BTU/SF/YR (3179 WH/SF/YR), of the maximum allowable energy a building can consume based on weather region and type of facility.

3.5. Building Envelope Heat Transmission (U) factors: Guidance for selecting insulating values is in the Building Envelope Component Guidelines table (Attachment 6)

3.6. Design Energy Usage (DEU): A quantity of energy a building is expected to consume within the five-foot line in BTU/SF/YR, over a 24-hour day, and 365-day year, based on design calculations. There is an energy distribution assessment (Attachment 4) for every building - one for each expected nonprocess source of energy load based on the same operating hours as the appropriate EUB. Each building's DEUs will be determined with unique calculations using the Fuel Conversion Factor table (Attachment 5).

3.6.1. Heating DEU (DEUHEAT): Energy used for heating the building environment. It includes the energy of the ventilation system when in the heating mode.

3.6.2. Cooling DEU (DEUCOOL): Energy used for cooling the building environment. It includes the energy of the ventilation system when in the cooling mode.

3.6.3. Ventilation DEU (DEUVENT): Energy used for ventilating the building environment. It is the fan energy for circulating air during an economizer cycle or when in neither the heating nor the cooling mode.

3.6.4. Lighting DEU (DEULIGHT): Energy used for lighting the building.

3.6.5. Domestic Hot Water DEU (DEUDHW): Energy used for heating domestic hot water.

3.6.6. Process Load DEU (DEUPRS): Energy used for process loads.

3.6.7. Special DEU: Energy used from all renewable energy sources such as active solar systems, geothermal, and wind.

3.6.8. Total DEU (TDEU): The sum of DEUHEAT, DEUCOOL, DEUVENT, DEULIGHT, and DEUDHW; does not include DEUPRS or any special DEUS. The PDC will automatically sum these five figures.

NOTE: Energy Budget Figure (EBF) and all variations thereof are superseded by the terminology in this ETL.

4. Specific Requirements. Three methods, described in 10 CFR 435, can be used to meet the energy compliance standards:

- o The Prescriptive/System alternative allows only limited flexibility with few tradeoffs in the design criteria. This method requires manual calculations or use of a simplified approved computer program, and is used primarily for small, simple facilities where minimal effort is required to meet energy criteria.
- o The Building Energy Cost Compliance alternative (not used by Air Force) uses a computer simulation to evaluate design based on annual energy cost.
- o The Building Energy method allows greater design flexibility to meet requirements for complex or multi-use facilities and must use an approved computer simulation program.

4.1. Procedure. Follow these steps to meet energy compliance requirements (Attachment 3):

STEP 1: MANDATORY: No exceptions. Prepare proposed designs in the following order:

- (1) envelope/orientation;
- (2) lighting;
- (3) auxiliary system/equipment;
- (4) electric power and distribution;
- (5) HVAC systems and equipment;
- (6) service hot water;
- (7) energy management systems.

Design and size mechanical equipment only after considering all energy conservation improvements to the building. All proposed designs must meet minimum compliance requirements as stated in 10 CFR 435 sections, part A: 3.3, Lighting; 4.3, Auxiliary System/Equipment; 5.3, Building Envelope; 6.3, Electric Power and Distribution; 7.3, HVAC Systems and Equipment; 9.3, Service Hot Water; and 10.3, Energy Management Systems.

STEP 2: Calculate compliance using one of the described methods based on design complexity or innovation. CHOOSE ONE.

a. Option 1, Prescriptive/System Alternative: For simple designs and additions/small facilities (under 3000 SF) where minimum effort and calculations are required to meet energy criteria. The Prescriptive method is the most basic, with minimum flexibility. The System method can be used for more innovative design, allowing flexibility in design of lighting and building envelope sections; but requires more manual calculations than the Prescriptive method. Facilities with a process load exceeding 60 percent must still meet the mandatory requirements in step 1 and use this option for the energy NOT considered process. Recommend using LTSGTD and ENVISTD computer programs, available from ASHRAE or Pacific Northwest Laboratories.

b. Option 2, Building Energy Alternative (computer simulation): For new facilities, additions over 3000 SF, or major renovations/repairs that are heated only or heated and/or air-conditioned. Use an approved, professionally recognized and proven computer program or programs that integrate architectural features with air conditioning, heating, lighting, and other energy-producing or consuming systems. Programs must be capable of simulating the features, systems, and thermal loads used in the design. Using established weather data files, the program must perform 8760 hourly calculations. The Building Load Analysis and Systems Thermodynamics (BLAST) and DOE 2.1C energy analysis programs are recognized by 10 CFR, Part 435, Subpart A, as acceptable programs.

Exceptions: Similar buildings in the same climatic zone (heating and cooling degrees days within 5 percent) do not require separate analyses. One computer analysis of the worst-case building (farthest north or north-south orientation) will serve to validate the remaining similar buildings. The MAJCOM or Design Agent shall determine whether or not the prior analysis should be modified with updated energy and construction costs. Document all exceptions, including the justification for not doing the energy analysis, in the project files.

STEP 3: Design compliance: Determine the appropriate EUB from the EUB table (Attachment 7), the Weather Region table (Attachment 8), and the Facility Type table (Attachment 9). Operating hours in the EUB table are provided by facility type. The TDEU must be less than or equal to the EUB. If the TDEU exceeds the EUB, revise the design to incorporate any other economically justified energy conservation measures. Optimize each facility design to its TDEU in addition to meeting the EUB. Document the Compliance Check on a Detailed Summary Form (Attachment 10) and in the PDC. Facilities with a process energy load exceeding 60 percent of the calculated total peak heating and/or cooling load are exempt from meeting the EUB.

STEP 4: Life-Cycle Cost Analysis: Use this analysis together with the energy analysis when evaluating multiple energy alternatives. BLAST's Life Cycle Cost In Design (LCCID) program is approved for this analysis. Other programs must meet the requirements as specified in 10 CFR 436, Part A, Methodology and Procedures for Life Cycle Cost Analyses and the Tri-service Memorandum Of Understanding (MOA).

4.2. Responsibilities.

4.1. MAJCOM, FOA, and DRU DMs and bases ensure the Compliance Check is successfully accomplished and documented in the project files.

4.2. MAJCOM, FOA, and DRU DMs and bases update all DEU elements in the PDC Energy screens and provide comments to the Design Agent regarding completeness and adequacy of the Compliance Check. The MAJCOM DM provides comments to AF/CEC regarding completeness and adequacy of the Compliance Check before design is completed.

4.3. HQ AFCESA/EN provides current EUB'S, fuel Uniform Present Worth values (UPWs), and escalation rates to AF/CEA for updating the PDC energy screens.

5. Point of Contact: Mr Freddie L. Beason, HQ AFCESA/ENM, DSN 523-6361 or commercial (904) 283-6361.

EDWARD E. WILSON, PE
Acting Director of Systems Engineering

10 Atch

1. Distribution List
2. ETL Index
3. ETL 94-4 Mandatory Performance Standards Flow Diagram
4. Air Force Energy Distribution Assessment Table
5. Fuel Conversion Factors table
6. Building Envelope Component Guidelines table
7. Energy Use Budgets table
8. Weather Region Definitions table
9. Facility Type table
10. Certificate of Compliance Detailed Summary Form

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SPECIAL INTEREST ORGANIZATIONS

HS (A. A. DeSimone) 1990 M Street NW, Suite 400 Washington DC 20036	(1)	Construction Criteria Database National Institute of Bldg Sciences 1201 L Street NW, Suite 400 Washington DC 20005	(1)
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ENGINEERING TECHNICAL LETTERS (ETL)

SECTION A - CURRENT ETLs

ETL Number	Title	Date Issued
83-1	Design of Control Systems for HVAC	16 Feb 83
	Change No. 1 to ETL 83-1, U.S. Air Force	
	Standardized Heating, Ventilating & Air	
	Conditioning (HVAC) Control Systems	22 Jul 87
83-3	Interior Wiring Systems, AFM 88-15, Para 7-3	2 Mar 83
83-4	EMCS Data Transmission Media (DTM)	
	Considerations	3 Apr 83
83-7	Plumbing, AFM 88-8, Chapter 4	30 Aug 83
83-8	Use of Air-to-Air Unitary Heat Pumps	15 Sep 83
83-9	Insulation	14 Nov 83
	Change 1 Ref: HQ USAF/LEEEU Msg 031600Z	
	MAY 84	1 Jun 84
84-7	MCP Energy Conservation Investment Program	
	(ECIP)	13 Jun 84
84-10	Air Force Building Construction and the Use of	
	Termi ticides	1 Aug 84
86-2	Energy Management and Control Systems (EMCS)	5 Feb 86
86-4	Paints and Protective Coatings	12 May 86
86-5	Fuels Use Criteria for Air Force Construction	22 May 86
86-8	Aqueous Film Forming Foam Waste Discharge	
	Retention and Di sposal	4 Jun 86
86-9	Lodging Facility Design Guide	4 Jun 86
86-10	Antiterrorism Planning and Design Guidance	13 Jun 86
86-14	Solar Applications	15 Oct 86
86-16	Direct Digital Control Heating, Ventilation,	
	and Air Conditioning Systems	9 Dec 86
87-1	Lead Ban Requirements of Drinking Water	15 Jan 87
87-2	Volatile Organic Compounds	4 Mar 87
87-5	Utility Meters in New and Renovated Facilities	13 Jul 87
87-9	Prewiring	21 Oct 87
88-2	Photovol taic Applications	21 Jan 88
88-3	Design Standards for Critical Facilities	15 Jun 88
88-4	Reliability & Maintainability (R&M) Design Checklist	24 Jun 88
88-6	Heat Distribution Systems Outside of Buildings	1 Aug 88
88-9	Radon Reduction in New Facility Construction	7 Oct 88
88-10	Prewired Workstations Guide Speci fication	29 Dec 88
89-2	Standard Guidelines for Submission of Facility	
	Operating and Maintenance Manuals	23 May 89

ENGINEERING TECHNICAL LETTERS (ETL)

SECTION A - CURRENT ETLs

ETL Number	Title	Date Issued
89-4	Systems Furniture Guide Specification	6 Jul 89
89-6	Power Conditioning and Continuation Interfacing Equipment (PCCIE) in the Military Construction Program (MCP)	7 Sep 89
89-7	Design of Air Force Courtrooms	29 Sep 89
90-1	Built-Up Roof (BUR) Repair/Replacement Guide Specification	23 Jan 90
90-2	General Policy for Prewired Workstations and Systems Furniture	26 Jan 90
90-3	TEMPEST Protection for Facilities Change 1 Ref: HQ USAF/LEEDE Ltr dated 20 April 90, Same Subject	23 Mar 90
90-5	Fuel and Lube Oil Bulk Storage Capacity for Emergency Generators	26 Jul 90
90-6	Electrical System Grounding, Static Grounding and Lightning Protection	3 Oct 90
90-7	Air Force Interior Design Policy	12 Oct 90
90-8	Guide Specifications for Ethylene Propylene Diene Monomer (EPDM) Roofing	17 Oct 90
90-9	Fire Protection Engineering Criteria for Aircraft Maintenance, Servicing, and Storage Facilities	2 Nov 90
90-10	Commissioning of Heating, Ventilating, and Air Conditioning (HVAC) Systems Guide Specification	17 Oct 90
91-1	Fire Protection Engineering Criteria Testing Halon Fire Suppression Systems	2 Jan 91
91-2	High Altitude Electromagnetic Pulse (HEMP) Hardening in Facilities	4 Mar 91
91-4	Site Selection Criteria for Fire Protection Training Areas	14 Jun 91
91-5	Fire Protection Engineering Criteria - Emergency Lighting and Marking of Exits	18 Jun 91
91-6	Cathodic Protection	3 Jul 91
91-7	Chlorofluorocarbon (CFC) Limitation in Heating, Ventilating and Air-Conditioning (HVAC) Systems	21 Aug 91
93-1	Construction Signs	11 Mar 93
93-2	Dormitory Criteria for Humid Areas	13 Jul 93
93-3	Inventory, Screening, Prioritization, and Evaluation of Existing Buildings for Seismic Risk	18 Aug 93

ENGINEERING TECHNICAL LETTERS (ETL)

SECTION A - CURRENT ETLs

ETL Number	Title	Date Issued
93-4	Fire Protection Engineering Criteria - Automatic Sprinkler Systems in Military Family Housing (MFH)	11 Aug 93
93-5	Fire Protection Engineering Criteria - Electronic Equipment Installations	22 Dec 93
94-1	Standard Airfield Pavement Marking Schemes	5 Apr 94
94-2	Utility Meters in New and Renovated Facilities	10 Jun 94
94-3	Air Force Carpet Standard	10 Jun 94
94-4	Energy Usage Criteria for Facilities in the Military Construction Program	19 Aug 94

ENGINEERING TECHNICAL LETTERS (ETL)

SECTION B - OBSOLETE ETLs

ETL Number	Date	Status
82-1	10 Nov 82	Superseded by ETLs 83-10, 86-1, 87-4
82-2	10 Nov 82	Superseded by AFEPPM 88-10
82-3	10 Nov 82	Superseded by ETLs 83-5, 84-2
82-4	10 Nov 82	Superseded by ETL 84-7
82-5	10 Nov 82	Superseded by ETLs 84-1, 86-13, 86-14
82-6	30 Dec 82	Cancelled
82-7	30 Nov 82	Cancelled
83-2	16 Feb 83	Superseded by ETL 84-3
83-5	5 May 83	Superseded by ETL 84-2
83-6	24 May 83	Cancelled
83-10	28 Nov 83	Superseded by ETL 86-1
84-1	18 Jan 84	Superseded by ETL 86-14
84-3	21 Mar 84	Cancelled
84-2	27 Mar 84	Superseded by ETL 94-4
84-4	10 Apr 84	Superseded by ETLs 86-7, 86-15, 87-5
84-5	7 May 84	Superseded by ETLs 84-8, 86-11, 86-18, 8-6
84-6	Not Issued	Cancelled/Not Used
84-8	19 Jun 84	Superseded by ETL 86-11
84-9	5 Jul 84	Superseded by ETL 88-7
88-5	2 Aug 88	Superseded by ETL 91-6
86-1	3 Feb 86	Superseded by ETL 87-7
86-3	21 Feb 86	Superseded by ETL 86-4
86-6	3 Jun 86	Superseded by ETLs 86-11, 86-18, 88-6
86-7	3 Jun 86	Superseded by ETL 86-15
86-11	3 Jul 86	Superseded by ETL 88-6
86-12	3 Jul 86	Superseded by ETL 90-2
86-13	18 Aug 86	Superseded by ETL 86-14
86-15	13 Nov 86	Superseded by ETL 87-5
86-17	17 Dec 86	Superseded by ETL 89-6
86-18	18 Dec 86	Superseded by ETL 88-6
87-3	12 Mar 87	Superseded by ETLs 87-6, ETL 88-5
87-4	13 Mar 87	Superseded by ETL 94-4
87-6	21 Aug 87	Superseded by ETL-88-5
87-7	14 Oct 87	Superseded by ETL 89-1
87-8	19 Oct 87	Superseded by ETL 90-1
88-1	5 Jan 88	Superseded by ETL 89-2
88-5	2 Aug 88	Superseded by ETL 91-6
88-7	24 Aug 88	Superseded by ETLs 90-3, 91-2
88-8	4 Oct 88	Superseded by ETL 91-7
89-1	6 Feb 89	Superseded by ETL 90-4
89-3	9 Jun 89	Superseded by ETL 93-5
89-5		Issued as ETL 90-7
90-4	24 May 90	Cancelled
91-8	24 Sep 91	Cancelled
91-3	14 Jun 91	Superseded by MIL HDBK 1008B, Jan 94

CONSTRUCTION TECHNICAL LETTERS (CTL)
SECTION C - CURRENT CTLs

CTL Number	Date	Status
88-2	6 Jan 88	DD Form 1354 Checklist
88-7	1 Nov 88	Constructibility Review Checklist
89-1	10 Apr 89	Thirty-Percent Design Submittal
89-2	30 May 89	MAJCOM Construction Management
89-3	22 Sep 89	Warranty and Guarantee Program
90-1	6 Mar 90	Management of the MILCON Planning and Execution Process
90-2	13 Mar 90	Definitions for Design Milestones

SECTION D - OBSOLETE CTLs

CTL Number	Status
87-1	Superseded by CTL 88-3
88-1	Superseded by CTL 90-1
88-3	Superseded by ETL
88-4	Replaced by Electronic Data File and Documentation in PDC/WIMS
88-5	Superseded by CTL 90-2
88-6	Issuance Cancelled

ENERGY USE BUDGETS (1,000 BTU/SF/YR)													
Facility Type*	Weather Regions**											Hours/ Day	Days/ Week
	1	2	3	4	5	6	7	8	9	10	11		
A1	55	55	45	45	45	45	40	35	35	40	40	10	5
A2	45	45	40	40	40	40	35	35	30	35	35	10	5
B	145	135	125	115	125	115	105	100	100	105	110	24	7
C	55	45	45	45	45	45	35	35	35	35	35	10	5
D	60	55	60	45	50	40	45	50	40	45	45	10	5
E	70	65	65	65	65	65	50	45	35	40	55	10	5
F	60	60	55	55	50	50	45	45	40	45	50	24	7
G	50	50	45	45	45	40	40	35	40	40	50	10	5
H	85	75	65	60	60	55	45	40	30	35	45	24	7
I	85	75	65	60	60	55	45	40	30	35	45	10	5
J	80	70	65	60	55	55	45	40	35	40	40	10	5
K	60	60	55	55	50	50	50	40	40	45	50	16	7
L	70	70	70	65	65	65	65	60	55	65	65	16	7
M	65	65	60	60	55	55	50	50	45	50	50	8	7
N	70	70	65	65	65	60	60	55	55	65	70	16	7
O	60	60	55	45	40	40	35	25	25	25	30	3	5
P	60	60	55	45	40	40	30	25	20	20	25	10	5
Q	70	65	60	55	55	45	45	45	40	45	50	16	7
R	75	65	65	55	55	50	40	35	25	30	45	24	7
S	55	50	45	40	35	25	20	15	15	20	20	24	7
T	45	65	70	80	85	85	85	80	70	75	90	24	7
U1	105	95	85	80	80	75	65	55	50	70	70	24	6
U2	90	80	70	65	65	60	50	50	45	50	60	24	6
V	100	95	85	80	80	70	65	55	55	55	65	12	6
W	95	95	80	75	65	65	55	45	40	45	55	10	5
X	35	30	30	25	25	20	20	20	15	20	20	24	7

*See Attachment 8.

**See Attachment 7.

AIR FORCE ENERGY DISTRIBUTION

FACILITY TYPE (SF)	HEATING	COOLING	LIGHTING	VENT	DHW
Small Offices (<8000)					
for 1000 < HDD < 7000	25%	20%	40%	10%	5%
for HDD > 7000	40%	--	40%	10%	10%
Large Offices (>8000)					
for 1000 < HDD < 7000	25%	20%	35%	15%	5%
for HDD > 7000	40%	--	35%	15%	10%
Hospitals					
for 1000 < HDD < 4000	20%	40%	20%	15%	5%
for 4000 < HDD < 7000	40%	15%	20%	15%	10%
for HDD > 7000	55%	--	20%	15%	10%
Clinics & Dispensaries					
for 1000 < HDD < 4000	15%	40%	30%	10%	5%
for 4000 < HDD < 7000	30%	25%	30%	10%	5%
for HDD > 7000	50%	--	30%	10%	10%
Training Facilities					
for 1000 < HDD < 4000	20%	40%	25%	5%	10%
for 4000 < HDD < 7000	45%	15%	25%	5%	10%
for HDD > 7000	55%	--	25%	5%	15%
Community Type Facilities					
for 1000 < HDD < 4000	15%	30%	35%	15%	10%
for 4000 < HDD < 7000	25%	20%	35%	10%	10%
for HDD > 7000	40%	--	35%	15%	10%
Dining Facilities					
for 1000 < HDD < 4000	15%	40%	20%	15%	10%
for 4000 < HDD < 7000	25%	30%	20%	15%	10%
for HDD > 7000	45%	--	20%	20%	15%
Clubs					
for 1000 < HDD < 4000	20%	35%	15%	20%	10%
for 4000 < HDD < 7000	30%	30%	15%	15%	10%
for HDD > 7000	55%	--	15%	15%	15%

AIR FORCE ENERGY DISTRIBUTION (Continued)

FACILITY TYPE (SF)	HEATING	COOLING	LIGHTING	VENT	DHW
ASSEMBLY TYPE FACILITIES -					
for 1000 < HDD < 4000	15%	30%	30%	20%	5%
for 4000 < HDD < 7000	30%	15%	30%	15%	10%
for HDD > 7000	40%	--	30%	15%	15%
STORAGE TYPE FACILITIES & MAINTENANCE FACILITIES					
for 1000 < HDD < 4000	15%	35%	30%	19%	1%
for 4000 < HDD < 7000	60%	15%	20%	4%	1%
for HDD > 7000	75%	--	20%	4%	1%

FUEL CONVERSION FACTORS

Types of Fuel	Conversion Factors	
	Non-Metric	Metric
Anthracite Coal	25.4 M Btu/short ton	9.17 kWh/kg
Bituminous Coal	24.6 M Btu/short ton	7.971 kWh/kg
Electricity	3,413 Btu/kWh	1 kWh/kWh
No. 2 Distillate Fuel Oil	138,700 Btu/gal	10.775 kWh/liter
Residual Fuel Oil	149,700 Btu/gal	11.63 kWh/liter
Kerosene	135,000 Btu/gal	10.49 kWh/liter
LP Gas	95,500 Btu/gal	7.652 kWh/liter
Natural Gas	1,031 Btu /ft ³	10.66 kWh/m ³
Purchased Steam or Steam from Central Plant	1,000 Btu/lb	0.675 kWh/kg

NOTES:

1. For high temperature, medium temperature, or chilled water from a central plant, use the heat value of fluid based on the actual temperature and pressure delivered to the 5 foot [1.5 meter] line of the designed building.
2. The EUB values assume that no electric resistive heating will be used in the building (except auxiliary electric resistive heating used with heat pump systems). When 10 percent or more of a building's annual heating consumption will be derived from electric resistive heating, multiply the electric resistive calculation by 2.2 to reflect additional conversion losses.
3. At specific installations where the energy source Btu content is known to vary consistently by 10 percent or more from the values given above, the local value may be used, provided there is adequate data on file (two years or more) to justify the revision, and this value is expected to hold true for at least five years following building occupancy.

BUILDING ENVELOPE COMPONENT GUIDELINES [1, 11]
(All U Value Factors are maximums; R value factors are minimum)

Weather Region	Opaque Wall U[2]	Gross Wall U[3]	Below Grade R[4]	Glazing Type[5]	Roof/ Ceiling U	Exposed Floor U[6]
1[7]	.053/.040[8]	.125/.091[9]	18	D/T[10]	.024	.023
2	.053	.147	16	D	.031	.040
3	.053	.147	15	D	.031	.040
4	.066	.164	13	D	.041	.040
5	.064	.181	12	D	.041	.040
6	.092	.210	10	D	.052	.049
7	.088	.212	9	D	.055	.048
8	.120	.217	8[12]	S	.066	.074
9	.230	.340	0	S	.100	.180
10	.150	.270	0	S	.057	.100
11	.150	.270	8[12]	S	.057	.100

NOTES:

[1] Values in this table may be used as a starting point in the building design. Use is optional, except Region 1 values are mandatory. Values were derived from guidance in 10 CFR 435 for a typical Air Force building in several representative climatic areas. Depending on the type of building, local construction and energy costs, and microclimate, more energy efficient and/or life cycle cost effective U values (higher or lower) are possible. Final design will depend upon further energy and economic study, generic study results, engineering judgment, or a combination of these. Since many buildings are not "envelope load dominate," use of these values does not guarantee a building's DEU will meet the appropriate EUB value.

[2] Opaque wall U factors must be calculated in accordance with the ASHRAE Handbook of Fundamentals. Calculations must take into account all major thermal bridges, and series and parallel heat conductive paths.

[3] Gross wall U factor is the average U factor of all wall components (opaque walls, windows, doors, openings) determined by multiplying the respective U factor by the area of each wall component, then dividing the sum of the products for all wall components by the total wall area (weighted average).

NOTES (Continued):

[4] Below grade wall R factors are minimum values for exterior wall assemblies (in contact with earth) of below-grade conditioned spaces. Air film coefficients and thermal performance of the adjacent ground are excluded from these values.

[5] D = Double glazing with a minimum of 1/4-inch air space.
S = Single glazing with a minimum thickness of 1/8 inch.
T = Triple glazing.

[6] Exposed floor U factors are for floors of heated spaces over unheated areas such as open areas, garages, crawl spaces, and basements without a positive heat supply to maintain a minimum temperature of 50° F (10° C).

[7] ALL VALUES INDICATED FOR REGION 1 ARE MANDATORY LIMITS. These values have been adjusted to comply with the special minimum requirements for this region in 10 CFR 435 Subpart A.

[8] Maximum U factor of 0.40 is required for all buildings with less than 12,000 SF floor area.

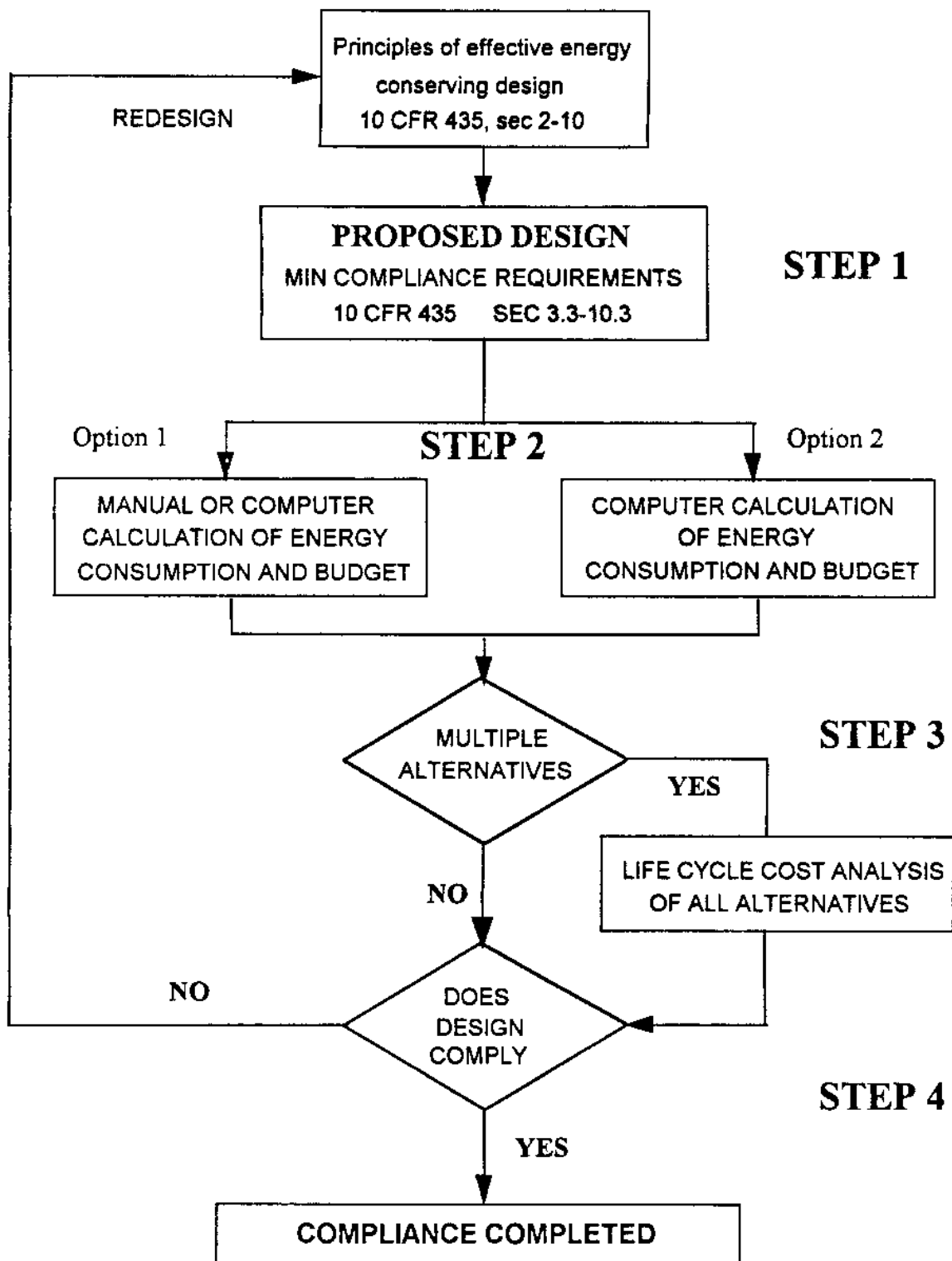
[9] Maximum U factor of 0.91 is required for all buildings with greater than 12,000 SF floor area.

[10] Maximum U factor for fenestration in Region 1 is 0.450, which normally will require double glazing with an emissivity coating or triple glazing. No translucent roofing systems (skylights, light monitors) are permitted in Region 1.

[11] Refer to CEGS 03300 for mandatory slab on grade perimeter insulation requirements.

[12] For locations in Regions 8 and 11 having Heating Degree Days less than 3000, the below grade wall R factor may be 0.

ETL 94-4 Mandatory Performance Standards Flow Diagram



NOTES:

1. DEUs and EUBs do not predict actual energy consumption for the completed facility. They are only guidelines for determining the relative energy consciousness of energy alternative models. Used in this context, a building design that complies with its EUB, all other factors being equal, will very likely consume less energy than one that does not.

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(1 of 2)

2. The EUB, given in 1,000 BTU/SF/YR [3179 WH/SF/YR], pertains to the energy consumed by buildings within the 5-foot [1.5-meter] line of the building with the following exceptions:

- o Include energy required to operate energy plants, systems, and equipment (including distribution system losses and gains) which rest outside the 5-foot [1.5-meter] line, and which serve a single building (such as a remote packaged chiller, cooling tower, substation or heating plant) in total in the DEU of the designed building.
- o Include energy furnished by plants as steam, high or medium temperature hot water, or chilled water, which serve more than one building in the DEU calculation of the designed building. Allow credit for energy content of condensate of water returning to the central plant. Do not include energy losses and gains from the distribution system between the plant and the buildings, as well as the energy conversion losses of the plant itself (other than that taken into account in the fuel conversion factors table) in the connected building's DEU.

3. If another distinct function (facility type) is being performed in the area which comprises 10 percent or more the building's gross floor area, normalize the EUB by using the following formula:

$$\text{EUB} = \text{EUB1} (\text{A1/AT}) + \text{EUB2} (\text{A2/AT}) + \dots + \text{EUBN} (\text{AN/AT})$$

where:

EUB is for the mixed use building,

EUBN is for one of the distinct functional areas,

AN is the gross floor area devoted to function N, and

AT is the total gross floor area of the building.

4. The gross floor area of a building is the sum of all floor areas, measured from the outside of exterior walls or from the center line of partitions, including basements, cellars, mezzanines, other intermediate floor tiers, and penthouses.

WEATHER REGION DEFINITIONS

Weather Region	Cooling Degree Days	Heating Degree Day Range (Base 65 deg. F)	
1	N/A	> 15000	N/A
2	N/A	> 13000	< / = 15,000
3	N/A	> 11000	< / = 13,000
4	< 2000	> 9000	< / = 11,000
5	< 2000	> 7000	< / = 9000
6	< 2000	> 5500	< / = 7000
7	< 2000	> 4000	< / = 5500
8	< 2000	> 2000	< / = 4000
9	< 2000	N/A	< / = 2000
10	> 2000	N/A	< / = 2000
11	> 2000	> 2000	N/A

NOTES:

1. Use data in AFM 88-29 to select the appropriate weather region.
2. Weather Regions 1, 2, and 3 are determined by the Heating Degree Day Range independent of the Cooling Degree Day.
3. Weather Regions 4, 5, 6, 7, 8, and 9 are determined by the Cooling Degree Days being less than 2000, and then by the appropriate range bracket of the Heating Degree Day.
4. Weather Regions 10 and 11 are determined by the Cooling Degree Days being greater than 2000, and then by the appropriate range bracket of Heating Degree Day.

FACILITY TYPE

Facility Type	Facility Function	Limitations
A1	Admin, Operations, Office, Police Stations	(Over 8,000 SF)
A2		(Under 8,000 SF)
B	Hospital Buildings	None
C	Medical /Dental Laboratories	None
D	Dental Clinics	None
E	Dispensaries	None
F	Prisons	None
G	Schools, Training and Education Centers, Classrooms, Child Care	None
H	Fire Stations	None
I	Auto Hobby Shops	None
J	Post Offices, Chapels, Banks, Libraries, Credit Unions, Thrift Shops, Miscellaneous Recreation Buildings, Art and Crafts Buildings	None
K	Gyms, Indoor Pool Buildings, Field Houses, Cadet Activity Centers	None
L	Clubs (NCO, Officer's, Recreation, Rod and Gun, Youth Center	None
M	Theaters, Passenger Terminals	None
N	Dining Hall, Cafeteria, Snack Bar, Open Mess, Restaurants	None
O	Auditoriums	None
P	Museums, Memorials	None
Q	UPH, Dormitories, Transient Billeting, Cadet Housing	None
R	Storage (Medical, Munitions, Range Targets, Forms), Medical Logistics, Kennel Support, Material Process Depot	None
S	Storage (Freight, Missile, Ammunitions), Aircraft Shelter, Air Freight Terminal, Range Supplies and Equipment Storage, Indoor Small Arms Range, Parking Shed, Depot Warehouse, Hazardous Material Storage	None

T	Cold Storage	None
U1	Maintenance (Hangars, Tac Shops, Docks, Vehicle	Ceilings > 10 FT
U2	Facilities), High Bay Technical Training Areas	Ceilings < 10 FT
V	Commissary, Base Exchange, Package Store, Service Outlet	None
W	Electronics, Laboratories, Control Towers, Communication Facilities, Instrument Shops	None
X	Utility Plants (Boiler, Electricity Production, Sewage Treatment, Chiller)	None

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CERTIFICATE OF COMPLIANCE
DETAILED SUMMARY

INSTALLATION: _____ HOST MAJCOM: _____
PROJECT TITLE: _____ PDC NO: _____
DESIGN AGENT: _____ MAJCOM DM: _____
DESIGN FIRM: _____

ALL REQUIRED DATA HAS BEEN ENTERED INTO THE PDC SYSTEM:

BASE _____ MAJCOM _____ AF/CE _____

I. BUILDING EUB

	FACILITY TYPES	AREA	EUB	HRS/DAY	DAYS/WK
1.	_____	_____	_____	_____	_____
2.	_____	_____	_____	_____	_____
3.	_____	_____	_____	_____	_____

OVERALL GROSS SQUARE FOOTAGE: _____ OVERALL EUB: _____

II. BUILDING INTERNAL _____ OCCUPANTS

III. SUMMARY

TITLE	AMOUNT	REMARKS
DEUHEAT		
DEUCOOL		
DEUVENT		
DEULIGHT		
DEUDHW		
TDEU		
DEUPRS		
SPECIAL DEU 1		
SPECIAL DEU 2		

The design agent certifies that this project has been designed to the required Federal performance standards (10 CFR 435) to achieve the maximum practical improvements in energy efficiency and increases in the use of renewable sources of energy at the least life-cycle cost.

DESIGN AGENT: _____ DATE: _____

The construction agent certifies that this completed facility has been constructed IAW the approved design and that all energy systems and equipment are included without substitution, unless approved by the DA.

CONSTRUCTION AGENT: _____ DATE: _____

REVIEWED BY: MAJCOM DM _____ AF/CEC _____ AFCESA/ENM _____

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